Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

THE LIBRARY OF
CONGRESS
SERIAL RECORD
APR 8 1944
Copy/
GOVT. SOURCE

Maine Agricultural Experiment Station

BULLETIN No. 67. SEPTEMBER, 1900.

DIGESTION EXPERIMENTS WITH SHEEP.

NOTE ON HEATS OF COMBUSTION.

This Bulletin contains the detailed results of 16 digestive experiments with sheep on clover hay and silage, oat and pea hay and silage, oat and vetch hay, Timothy hay, oats, germ meal, oat feed and adulterated wheat bran; and a comparison of calculated and determined heats of combustion.

Requests for the Bulletins should be addressed to the
Experiment Station,
Orono, Maine.

MAINE

AGRICULTURAL EXPERIMENT STATION

ORONO, MAINE.

THE STATION COUNCIL.

President Abram W. Harris	*President*
Director Charles D. Woods	*Secretary*
Edward B. Winslow, Portland	*Committee of Board of Trustees*
Voranus C. Coffin, Harrington	
John A. Roberts, Norway	
B. Walker McKeen, Fryeburg	*State Board of Agriculture*
Eugene Harvey Libbey, Auburn	*State Grange*
Charles S. Pope, Manchester	*State Pomological Society*
James M. Bartlett	*Members of the Station Staff*
Lucius H. Merrill	
Fremont L. Russell	
Welton M. Munson	
Gilbert M. Gowell	
Gilman A. Drew	

THE STATION STAFF.

The President of the University.

Charles D. Woods	*Director*
James M. Bartlett	*Chemist*
Lucius H. Merrill	*Chemist*
Fremont L. Russell	*Veterinarian*
Welton M. Munson	*Horticulturist*
Gilbert M. Gowell	*Stock Breeding and Poultry*
Gilman A. Drew	*Entomologist*
Lucius J. Shepard	*Assistant in Agriculture*
Ora W. Knight	*Assistant Chemist*
Edward R. Mansfield	*Assistant Chemist*
Clifford D. Holley	*Assistant Chemist*

DIGESTION EXPERIMENTS WITH SHEEP.

J. M. Bartlett.

Several digestion experiments with sheep have been made since the last work of this nature was published in the Station Report for 1898*, and the results are presented in the following pages. The larger part of the work was done in 1899, but a few of the experiments were made in 1898 and the early part of 1900. The chief object of the experiments was to determine the nutritive value of the several fodders and feeds used in connection with feeding experiments and growing forage crops.

The method followed was practically the same as has been used heretofore at the Station, namely: Each experiment covered a period of twelve days, the first seven being devoted to preliminary feeding, and the last five to the experiment proper during which time the pouches were attached to the sheep and all the excrement collected, dried, weighed, and sampled for analysis. The rations were uniform and weighed throughout the twelve days. The coarse fodders were finely chopped, thoroughly mixed to make them uniform, and a small sample was taken out each time the sheep were fed to make a composite sample for analysis. In most of the experiments three or four sheep were employed, but in a few cases only two were used. Seven different sheep were used in all. The four used in 1899, not being very satisfactory, were replaced by other strong young wethers in January, 1900.

MATERIALS FED IN THE EXPERIMENTS.

Clover hay: Made largely of alsike clover cut early in July when nearly all the plants were in bloom.

---

* Digestion experiments with sheep have been conducted at this station since 1885, and the results are given in the Reports for 1886, 1887, 1888, 1889, 1890, 1891, 1893, 1894, 1896, 1897 and 1898. The Report for 1891 contains a description of the digestion room, stalls, harness, etc., used in the experiments.

Clover hay: Made largely of alsike clover, from same field as the preceding lot, cut about ten days later when many of the plants were past bloom.

Clover silage: Made from the late cut clover described above. The material was well preserved in the silo and when fed was in good condition, well relished by the animals.

Corn meal: Made from ordinary western corn, rather coarsely ground.

Oats: Maine grown, medium quality, fed whole.

Hay: Largely timothy, fed with oats.

Oat and pea hay: Harvested when oats were in milk. The seeding was 1½ bushels oats and 1½ bushels Canada field peas to the acre.

Oat and pea silage: Same material as used for the hay, cut when the oats were in the milk and run through the ensilage cutter before putting in the silo.

Oat and vetch hay: Made from ordinary oats and sand vetch, *Vicia villosa,* cut when the oats were in milk. Seeding, one bushel oats and one bushel vetch to the acre.

Oat and vetch hay: Made from ordinary oats and spring vetch, *Vicia sativa.*

Oat and pea hay: Made from ordinary oats and Canada field peas, cut when the oats were in milk. Seeding, one bushel oats and two bushels peas to the acre.

Hay: Largely timothy.

Germ meal: A corn product resembling gluten feed.

Oats: Maine oats of first quality, very plump and heavy, fed whole.

Royal Oat Feed: An oat feed put out by the Akron Cereal Company.

Kentucky Mixed Feed: Wheat bran, adulterated.

THE COMPOSITION OF FEEDING STUFFS USED IN DIGESTION EXPERIMENTS IN 1899.

	Station number.	Water.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.
ON FRESH BASIS.		%	%	%	%	%	%
Clover cut in early bloom	4152	19.21	7.80	12.60	23.36	35.24	1.79
Clover cut in late bloom	4156	17.73	6.92	11.99	24.25	36.71	2.40
Clover silage	4160	78.84	2.20	2.56	7.87	7.71	.82
Clover hay	4163	19.28	7.38	12.08	25.36	34.34	1.56
Hay, mostly timothy	4170	11.81	5.92	9.24	26.76	44.12	2.15
Oat and pea hay	4174	14.50	7.99	14.41	26.84	33.69	2.57
Oat and pea silage	4202	73.80	2.05	3.34	8.75	10.45	1.61
Oat and vetch hay	4212	21.08	5.49	7.71	26.12	37.20	2.30
Oat and vetch hay	4217	20.00	6.07	8.51	24.93	37.68	2.81
Oat and pea hay	4222	25.08	5.93	10.31	25.01	31.45	2.22
Hay, mostly timothy.	4235	13.00	5.32	6.19	28.21	44.91	2.37
Oats	4145	11.15	2.92	12.56	11.28	57.70	4.39
Corn meal	4180	14.55	1.60	9.63	2.18	69.17	2.87
Oats	4234	13.16	3.15	11.38	10.31	57.06	4.94
Germ meal	4227	9.58	3.57	22.94	21.45	32.26	10.20
ON WATER-FREE BASIS.							
Clover hay (cut in early bloom)	4152	....	9.66	15.59	28.91	43.62	2.22
Clover hay (cut in late bloom)	4156	....	8.41	14.57	29.47	44.63	2.92
Clover silage	4160	....	10.39	12.10	37.18	36.45	3.88
Clover hay.	4163	....	9.14	14.96	31.42	42.55	1.93
Hay, mostly timothy	4170	....	6.71	10.49	30.34	50.02	2.44
Oat and pea hay	4174	....	9.35	16.85	31.39	39.41	3.00
Oat and pea silage	4202	....	7.83	12.74	33.40	39.90	6.13
Oat and vetch hay	4212	....	6.95	9.77	33.10	47.26	2.92
Oat and vetch hay	4217	....	7.59	10.64	31.16	47.10	3.51
Oat and pea silage	4222	....	7.91	13.76	33.38	41.99	2.96
Hay, mostly timothy	4235	....	6.11	7.12	32.43	51.62	2.72
Oats	4145	....	3.28	14.09	12.70	64.99	4.94
Corn meal	4180	....	1.87	11.27	2.55	80.95	3.36
Oats	4234	....	3.63	13.10	11.87	65.71	5.69
Germ meal	4227	....	3.95	25.37	23.72	35.68	11.28

DIGESTION EXPERIMENT 70—CLOVER HAY CUT IN EARLY BLOOM.

RATIONS.

Fed Sheep I 600 grams per day.
Fed Sheep II 600 grams per day.
Fed Sheep III 600 grams per day.

COMPOSITION OF FODDER AND FECES.

	Station number.	Dry matter.	WATER-FREE.						
			Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Calories.
FODDER.		%	%	%	%	%	%	%	
Early cut clover.	4152	80.8	90.34	9.66	15.59	28.91	43.62	2.22	4367
FECES.									
Sheep I.	4153	......	86.27	13.73	12.94	32.94	36.69	3.70	4552
Sheep II..........	4154	....	88.91	11.09	12.80	32.05	40.10	3.96	4719
Sheep III.........	4155	....	86.80	13.20	11.91	33.56	37.67	3.66	4560

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED IN FIVE DAYS AND PERCENTAGES DIGESTED.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
SHEEP I.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Early cut clover	2424.0	2189.8	234.2	377.9	700.8	1057.3	53.8
Feces	943.6	814.0	129.6	122.1	310.8	346.2	34.9
Amount digested	1480.4	1375.8	104.6	255.8	390.0	711.1	18.9
Per cent digested	61.1	62.8	44.7	67.7	55.6	67.3	35.1
SHEEP II.							
Early cut clover	2424.0	2189.8	234.2	377.9	700.8	1057.3	53.8
Feces	1074.1	955.0	119.1	137.5	344.3	430.7	42.5
Amount digested	1349.9	1234.8	115.1	240.4	356.5	626.6	11.3
Per cent digested	55.7	56.4	49.1	63.6	50.9	59.3	21.0
SHEEP III.							
Early cut clover	2424.0	2189.8	234.2	377.9	700.8	1057.3	53.8
Feces	1064.3	923.8	140.5	126.8	357.2	400.9	38.9
Amount digested	1359.7	1266.0	93.7	251.1	343.6	656.4	14.9
Per cent digested	56.1	57.8	40.0	66.4	49.0	62.1	27.7
Average	57.6	59.0	44.6	65.9	51.8	62.9	27.9

FUEL VALUES FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Fuel value of urea.	Total available fuel value.	Per cent available fuel value.
FODDER: EARLY CUT CLOVER.						
Sheep I	10586	4265	6321	223	6098	57.6
Sheep II	10586	5069	5517	209	5308	50.2
Sheep III	10586	4853	5733	218	5515	52.1

DIGESTION EXPERIMENT 71—CLOVER HAY CUT IN LATE BLOOM.

RATIONS.

Fed Sheep I 600 grams per day.
Fed Sheep II 600 grams per day.
Fed Sheep III 600 grams per day.

COMPOSITION OF FODDERS AND FECES.

	Station number.	Dry matter.	Water-Free.						
			Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.	Calories per gram.
Fodder.		%	%	%	%	%	%	%	
Late cut clover..	4156	82.3	91.59	8.41	14.57	29.47	44.63	2.92	4350
Feces.									
Sheep I..........	4157	....	87.78	12.22	11.07	37.52	35.27	3.92	4534
Sheep II..........	4158	....	87.74	12.26	9.30	38.92	34.78	4.76	4745
Sheep III.........	4159	....	89.55	10.45	11.82	35.96	37.73	4.04	4563

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED IN FIVE DAYS AND PERCENTAGES DIGESTED.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
SHEEP I.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Late cut clover	2469.0	2261.3	207.6	359.7	727.6	1101.9	72.1
Feces	1086.5	953.7	132.8	120.3	407.6	383.2	42.6
Amount digested	1382.5	1307.6	74.8	239.4	320.0	718.7	29.5
Per cent digested	56.0	57.8	36.0	66.5	44.0	65.2	40.9
SHEEP II.							
Late cut clover	2469.0	2211.3	207.6	359.7	727.6	1101.9	72.1
Feces	1118.1	981.0	137.1	104.0	435.2	388.6	53.2
Amount digested	1350.9	1280.3	70.5	255.7	292.4	713.3	18.9
Per cent digested	54.7	56.6	34.0	71.1	40.2	64.7	26.2
SHEEP III.							
Late cut clover	2469.0	2261.3	207.6	359.7	727.6	1101.9	72.1
Feces	1083.0	969.8	113.2	128.0	389.4	408.6	43.8
Amount digested	1386.0	1291.5	94.4	231.7	338.2	693.3	28.3
Per cent digested	56.1	57.1	45.4	64.4	46.5	62.9	39.2
Average	55.6	57.2	38.5	67.3	43.6	64.3	35.4

FUEL VALUE FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Fuel value of urea.	Total available fuel value.	Per cent available fuel value.
LATE CUT CLOVER.						
Sheep I	10740	4926	5814	198	5616	52.3
Sheep II	10740	5305	5435	223	5212	48.5
Sheep III	10740	4942	5798	202	5596	52.1

DIGESTION EXPERIMENT 72—CLOVER SILAGE MADE FROM CLOVER CUT IN LATE BLOOM.

RATIONS.

Fed Sheep I 3,000 grams per day.
Fed Sheep II 3,000 grams per day.
Fed Sheep III 3,000 grams per day.

COMPOSITION OF FODDER AND FECES.

	Laboratory number.	Dry matter.	WATER-FREE.						
			Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Calories per gram.
FODDER.		%	%	%	%	%	%		
Clover silage.....	4160	21.2	89.61	10.39	12.10	37.18	36.45	3.88	4652
FECES.									
Sheep I.........	4161	....	89.36	10.64	15.21	34.63	35.28	4.24	4720
Sheep III........	4162	....	86.24	13.76	15.41	35.22	32.37	3.24	4506

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED IN FIVE DAYS AND PERCENTAGES DIGESTED.

	Dry substance.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
SHEEP I.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Clover silage	3180.0	2849.6	330.4	384.8	1182.3	1159.1	123.4
Feces	1523.1	1361.0	162.1	231.7	527.4	537.3	64.6
Amount digested	1656.9	1488.6	168.3	153.1	654.9	621.8	58.8
Per cent digested	52.1	52.2	50.9	39.8	55.4	53.7	47.7
SHEEP III.							
Clover silage	3180.0	2849.6	330.4	384.8	1182.3	1159.1	123.4
Feces	1510.4	1302.6	207.8	232.8	532.0	488.9	48.9
Amount digested	1669.6	1547.0	122.6	152.0	650.3	670.2	74.5
Per cent digested	52.5	54.3	37.1	39.5	55.0	57.9	60.4
Average	52.3	53.3	44.0	39.7	55.2	55.8	54.1

FUEL VALUE FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Fuel value of urea.	Total available fuel value.	Per cent available fuel value.
CLOVER SILAGE.						
Sheep I	14793	7199	7594	133	7461	50.4
Sheep III	14793	6806	7987	132	7855	53.1

DIGESTION EXPERIMENT 73—CORN MEAL FED WITH CLOVER HAY.

RATIONS.

Fed Sheep I corn meal 300 grams, clover 400 grams per day.
Fed Sheep II corn meal 300 grams, clover 400 grams per day.
Fed Sheep III corn meal 300 grams, clover 400 grams per day.

COMPOSITION OF FODDER AND FECES.

	Station number.	Dry matter.	Water-free.						
			Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.	Calories per gram.
Fodder.		%	%	%	%	%	%	%	
Clover hay	4163	80.7	90.86	9.14	14.96	31.42	42.55	1.93	4370
Corn meal	4180	85.5	98.13	1.87	11.27	2.55	80.95	3.36	4352
Feces.									
Sheep I	4164	....	88.32	11.68	15.55	32.44	36.53	3.80	4727
Sheep II	4165	....	89.98	10.02	15.68	31.67	39.26	3.37	4649
Sheep III	4166	....	87.54	12.46	12.01	33.56	39.23	2.74	4631

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED FOR FIVE DAYS AND PERCENTAGES DIGESTED.

	Dry matter.	Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.
Sheep I.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Fed in clover hay	1614.0	1466.5	147.5	241.5	507.1	686.8	31.1
Fed in corn meal	1282.5	1258.5	24.0	144.5	32.7	1038.2	43.1
Total fed	2896.5	2725.0	171.5	386.0	539.8	1725.0	74.2
Total feces	815.7	720.4	95.3	126.8	264.6	298.0	31.0
Total digested	2080.8	2004.6	76.2	259.2	275.2	1427.0	43.2
Digested from clover hay	903.8	847.6	53.1	160.6	223.1	447.8	12.7
Digested from corn meal	1177.0	1157.0	23.1	98.6	52.1	979.2	30.5
Per cent digested from corn meal	91.8	91.9	96.2	68.2	....	94.3	70.8
Sheep II.							
Fed in clover hay	1614.0	1466.5	147.5	241.5	507.1	686.8	31.1
Fed in corn meal	1282.5	1258.5	24.0	144.5	32.7	1038.2	43.1
Total fed	2896.5	2725.0	171.5	386.0	539.8	1725.0	74.2
Total feces	907.8	816.8	91.0	142.3	287.5	356.4	30.6
Total digested	1988.7	1908.2	80.5	243.7	252.3	1368.6	43.6
Digested from clover hay	882.9	830.0	50.2	153.6	203.9	444.4	8.1
Digested from corn meal	1105.8	1078.2	30.3	90.1	48.4	924.2	35.5
Per cent digested from corn meal	86.2	85.7	....	62.4	....	89.0	82.3
Sheep III.							
Fed in clover hay	1614.0	1466.5	147.5	241.5	507.1	686.8	31.1
Fed in corn meal	1282.5	1258.5	24.0	144.5	32.7	1038.2	43.1
Total fed	2896.5	2725.0	171.5	386.0	539.8	1725.0	74.2
Total feces	869.6	761.2	108.4	104.5	291.8	341.1	23.8
Total digested	2026.9	1963.8	63.1	281.5	248.0	1383.9	50.4
Digested from clover hay	905.5	837.4	67.0	155.5	235.8	432.0	12.2
Digested from corn meal	1121.4	1126.4	3.9	126.0	12.2	951.9	38.2
Per cent digested from corn meal	87.4	89.5	16.2	87.2	37.3	91.7	88.6
Average	88.5	89.0	68.7	72.9	....	91.7	80.6

FUEL VALUES FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Fuel value of urea.	Total available fuel value.	Per cent available fuel value.
Corn Meal.						
Sheep I	5581	572	5009	86	4923	88.2
Sheep II	5581	683	4898	78	4820	86.3
Sheep III	5581	732	4748	110	4638	83.1

DIGESTION EXPERIMENT 74—HAY, MOSTLY TIMOTHY.

RATIONS.

Fed Sheep II 600 grams hay per day.

Fed Sheep IV 500 grams hay per day.

COMPOSITION OF FODDER AND FECES.

	Station number.	Dry matter.	Water-free.						
			Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.	Calories per gram.
FODDER.		%	%	%	%	%	%	%	
Hay	4170	88.2	93.29	6.71	10.49	30.34	50.02	2.44	4487
FECES.									
Sheep II	4168	... .	92.84	7.16	7.91	38.02	43.82	3.09	4741
Sheep IV	4169	....	92.42	7.58	9.36	36.32	43.45	3.29	4660

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED FOR THREE DAYS AND PERCENTAGES DIGESTED.

	Dry matter.	Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.
SHEEP II.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Hay	2646.0	2468.4	177.6	277.5	802.8	1323.5	64.6
Feces	1154.2	1071.6	82.6	91.3	438.8	505.8	35.7
Amount digested	1491.8	1396.8	95.0	186.2	364.0	817.7	28.9
Per cent digested	56.4	56.6	53.5	67 1	45.3	61.8	44.7
SHEEP IV.							
Hay	2205.0	2057.0	148.0	231.3	669.0	1102.9	53.8
Feces	908.9	840.0	68.9	85.1	330.1	394.9	29.9
Amount digested	1296.1	1217.0	79.1	146.2	338.9	708.0	23.9
Per cent digested	58.8	59.2	53.4	63.2	50.7	64.2	44.4
Average	57.6	57.9	53.5	65.2	48.0	63.0	44.6

FUEL VALUE FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Fuel value of urea.	Total available fuel value.	Per cent available fuel value.
HAY.						
Sheep II	11872	5472	6400	162	6238	52.6
Sheep IV	9894	4236	5658	126	5532	55.9

DIGESTION EXPERIMENT 75—OATS FED WITH HAY.

RATIONS.

Fed Sheep I oats, 400 grams; hay, 200 grams per day.

Fed Sheep II oats, 400 grams; hay, 200 grams per day.

Fed Sheep III oats, 400 grams; hay, 200 grams per day.

COMPOSITION OF FODDERS AND FECES.

	Station number.	Total dry matter.	WATER-FREE.						
			Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Ether extract.	Calories per gram.
FODDERS.		%	%	%	%	%	%	%	
Hay	4170	88.2	93.29	6.71	10.49	30.34	50.02	2.44	4487
Oats	4145	88.9	96.72	3.28	14.09	12.70	64.99	4.94	4683
FECES.									
Sheep I........	4171	....	91.01	8.99	11.21	31.04	45.90	2.86	4668
Sheep II........	4172	....	91.68	8.32	8.16	34.10	47.13	2.29	4542
Sheep III........	4173	....	90.69	9.31	11.24	30.84	45.77	2.84	4728

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED FOR FIVE DAYS AND PERCENTAGES DIGESTED.

	Dry substance.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
SHEEP I.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Fed in hay	882.0	822.8	59.2	92.5	267.6	441.2	21.5
Fed in oats	1778.0	1719.7	58.3	250.5	225.8	1155.5	87.9
Total fed	2660.0	2542.5	117.5	343.0	493.4	1596.7	109.4
Total feces	884.5	805.0	79.5	99.2	274.5	406.0	25.3
Total digested	1775.5	1737.5	38.0	243.8	218.9	1190.7	84.1
Digested from hay	508.0	476.4	31.7	60.3	128.4	278.0	95.9
Digested from oats	1267.5	1261.1	6.3	183.5	90.5	912.7	....
Per cent digested from oats	71.3	73.3	10.8	73.2	40.1	78.9	....
SHEEP II.							
Fed in hay	882.0	822.8	59.2	92.5	267.6	441.2	21.5
Fed in oats	1778.0	1719.7	58.3	250.5	225.8	1155.5	87.9
Total fed	2660.0	2542.5	117.5	343.0	493.4	1596.7	109.4
Total feces	972.7	891.8	80.9	79.4	331.7	458.4	22.3
Total digested	1687.3	1650.7	36.6	263.6	161.7	1138.3	87.1
Digested from hay	508.0	476.4	31.7	60.3	128.4	278.0	95.9
Digested from oats	1179.3	1174.3	4.9	203.3	33.3	860.3	....
Per cent digested from oats	66.3	68.3	8.4	81.1	14.7	74.5	....
SHEEP III.							
Fed in hay	882.0	822.8	59.2	92.5	267.6	441.2	21.5
Fed in oats	1778.0	1719.7	58.3	250.5	225.8	1155.5	87.9
Total fed	2660.0	2542.5	117.5	343.0	493.4	1596.7	109.4
Total feces	908.6	824.0	84.6	102.1	280.2	415.9	25.8
Total digested	1751.4	1718.5	32.9	240.9	213.2	1180.8	83.6
Digested from hay	508.0	476.4	31.7	60.3	128.4	278.0	95.9
Digested from oats	1243.4	1242.1	1.2	180.6	84.8	902.8	....
Per cent digested from oats	69.9	72.2	2.1	72.1	37.6	78.1	....
Average (%)	69.2	71.3	5.7	75.5	30.8	77.2	....

FUEL VALUE FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Fuel value of urea, etc.	Total available fuel value.	Per cent available fuel value.
Sheep I	8326	2364	5962	160	5802	69.7
Sheep II	8326	2653	5673	177	5496	60.1
Sheep III	8326	2531	5795	157	5638	61.7

DIGESTION EXPERIMENT 76—OAT AND PEA HAY.

RATIONS.

Fed Sheep I 600 grams per day.
Fed Sheep II 600 grams per day.
Fed Sheep III 400 grams per day.
Fed Sheep IV 400 grams per day.

WASTE LEFT BY EACH SHEEP FOR FIVE DAYS.

Sheep I.	Sheep II.	Sheep III.	Sheep IV.
251 grams.	291 grams.	257 grams.	167 grams.

COMPOSITION OF WASTE.

Water.	Ash.	Protein.	Nitrogen-free extract.	Fiber.	Fat.
24.54	6.99	4.58	29.99	32.85	1.05

COMPOSITION OF FODDER AND FECES.

			WATER-FREE.						
	Station number.	Dry matter.	Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.	Calories per gram.
FODDER.		%	%	%	%	%	%	%	
Oat and pea hay.	4174	85.50	90.65	9.35	16.85	31.39	39.41	3.00	4490
FECES.									
Sheep I	4176	....	89.54	10.46	12.16	32.51	40.77	4.10	4690
Sheep II	4177	....	89.62	10.38	13.13	32.67	39.74	4.08	4702
Sheep III	4178	......	88.45	11.55	15.13	29.23	40.00	4.09	4635
Sheep IV	4179	....	88.81	11.19	15.08	30.65	39.31	3.77	4402

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED IN FIVE DAYS AND PERCENTAGES DIGESTED.

	Dry matter.	Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.
SHEEP I.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Oat and pea hay	2380.0	2157.3	222.7	421.0	724.7	937.3	74.3
Feces	890.1	797.0	93.1	108.2	289.4	362.9	36.5
Amount digested	1489.9	1360.3	129.6	312.8	435.3	574.4	37.8
Per cent digested	62.6	63.1	58.2	74.3	60.1	61.3	50.9
SHEEP II.							
Oat and pea hay	2341.6	2122.5	219.1	418.6	708.0	922.1	73.8
Feces	777.0	696.3	80.7	102.0	253.8	308.8	31.7
Amount digested	1564.6	1426.2	138.4	316.6	454.2	613.3	42.1
Per cent digested	66.8	67.2	63.1	75.6	64.1	66.5	57.0
SHEEP III.							
Oat and pea hay	1516.0	1374.2	141.9	276.4	452.3	596.9	48.6
Feces	562.1	497.2	64.9	85.1	164.3	224.8	23.0
Amount digested	953.9	877.0	77.0	191.3	288.0	372.1	25.6
Per cent digested	62.9	64.0	54.4	69.2	63.7	62.3	52.7
SHEEP IV.							
Oat and pea hay	1584.0	1135.8	148.2	280.6	481.9	623.7	49.6
Feces	566.9	503.5	63.4	85.5	173.8	222.8	21.4
Amount digested	1017.1	632.3	84.8	195.1	308.1	400.9	28.2
Per cent digested	64.2	55.7	57.2	69.5	63.9	64.3	56.8
Average	64.2	62.5	58.2	72.2	63.0	63.7	54.4

FUEL VALUE FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Full value of urea.	Total fuel value.	Per cent fuel value.
PEAS AND OATS.						
Sheep I.	10685	4175	6510	272	6238	58.3
Sheep II	10513	3653	6860	275	6585	62.6
Sheep III	6806	2252	4554	166	4388	64.5
Sheep IV.	7112	2217	4895	170	4725	67.5

DIGESTION EXPERIMENT 77—OAT AND PEA SILAGE.

RATIONS.

Fed Sheep I 2,000 grams per day.
Fed Sheep II 2,000 grams per day.

WASTE LEFT BY EACH SHEEP FOR FIVE DAYS.

Sheep I.	Sheep II.
1060 grams.	286 grams.

COMPOSITION OF WASTE.

Water.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.
75.08	1.92	3.20	9.34	9.03	1.43

COMPOSITION OF FODDER AND FECES.

	Station number.	Dry matter.	Water-free.						
			Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Ether extract.	Calories.
FODDER.		%	%	%	%	%	%	%	
Oat & pea silage.	4202	26.2	92.17	7.83	12.74	33.40	39.90	6.13	4209
FECES.									
Sheep I	4204	....	88.1	11.90	10.24	35.46	38.54	3.86	4588
Sheep II	4205	......	90.15	9.85	8.61	38.04	40.19	3.31	4588

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED IN FIVE DAYS AND PERCENTAGES DIGESTED.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
SHEEP I.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Oat and pea silage	2358.0	2173.5	184.5	300.6	787.5	904.5	144.9
Feces	751.1	661.7	89.3	77.0	276.3	289.5	29.0
Digested	1606.9	1511.8	95.2	223.6	511.2	651.0	115.9
Per cent digested	68.1	69.6	51.6	74.4	64.9	69.9	73.1
SHEEP II.							
Oat and pea silage	2620.0	2415.0	205.0	334.0	875.0	1045.0	161.0
Feces	976.7	880.5	96.2	84.1	371.5	370.3	37.1
Digested	1643.3	1534.5	108.8	249.9	503.5	674.7	123.9
Per cent digested	62.8	63.5	53.1	74.8	57.6	64.1	76.9
Average per cent	65.5	66.6	52.4	74.6	61.3	67.0	75.0

FUEL VALUE FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Fuel value of urea.	Total available fuel value.	Per cent available fuel value.
FODDER: OAT AND PEA SILAGE.						
Sheep I	9926	3446	6480	195	6285	50.3
Sheep II	11027	4481	6546	217	6329	57.4

DIGESTION EXPERIMENT 78—OAT AND VETCH HAY.

RATIONS.

Fed Sheep I 500 grams per day.
Fed Sheep II 500 grams per day.
Fed Sheep III 500 grams per day.

WASTE LEFT BY EACH SHEEP FOR FIVE DAYS.

Sheep I.	Sheep II.	Sheep III.
90 grams.	56 grams.	108 grams.

COMPOSITION OF WASTE.

Water.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.
29.8	6.54	4.02	23.0	35.66	.98

COMPOSITION OF FODDERS AND FECES.

	Station number.	Dry matter.	Water-free.						
			Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Calories.
FODDER.		%	%	%	%	%	%	%	
Oat and vetch hay	4212	78.92	93.05	6.95	9.77	33.10	47.26	2.92	4410
FECES.									
Sheep I	4213	....	91.64	8.36	7.98	38.53	42.96	2.17	4742
Sheep II	4214	....	91.17	8.83	7.41	37.23	43.77	2.76	4486

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED IN FIVE DAYS AND PERCENTAGES DIGESTED.

	Dry substance.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
SHEEP I.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Oat and vetch hay	1909.1	1778.0	131.1	189.1	632.2	900.0	56.7
Feces	851.4	780.2	71.1	67.9	328.0	365.8	18.5
Amount digested	1057.7	997.8	59.9	121.2	304.2	534.2	38.2
Per cent digested	55.4	56.1	45.7	64.1	48.1	59.4	67.4
SHEEP II.							
Oat and vetch hay	1933.5	1800.1	133.4	190.5	640.2	912.3	57.1
Feces	863.9	787.6	76.3	64.0	321.6	378.1	23.9
Amount digested	1069.6	1012.5	57.1	126.5	318.6	534.2	33.2
Per cent digested	55.3	56.2	42.8	66.4	49.8	58.5	58.1
Average	55.4	56.2	44.3	65.3	49.0	59.0	62.8

FUEL VALUES FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Fuel value of urea.	Total available fuel value.	Per cent available fuel value.
FODDER: OAT AND VETCH HAY.						
Sheep I.	8419	4031	4388	106	4282	50.9
Sheep II	8527	3872	4655	110	4545	53.3

DIGESTION EXPERIMENT 79—OAT AND VETCH HAY.

RATIONS.

Fed Sheep I 500 grams per day.
Fed Sheep II 500 grams per day.
Fed Sheep III 500 grams per day.

COMPOSITION OF FODDERS AND FECES.

	Station number.	Dry matter.	Water-free.						
			Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Calories.
Fodder.		%	%	%	%	%	%	%	
Oat and vetch hay	4217	80.00	92.41	7.59	10.64	31.16	47.10	3.51	4342
Feces.									
Sheep I.........	4218	....	92.96	7.04	8.13	37.97	44.46	2.40	4611
Sheep II.	4219	....	92.00	8.00	7.92	39.39	42.44	2.25	4651
Sheep III.........	4220	....	92.09	7.91	8.50	35.99	45.32	2.28	4570

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED IN FIVE DAYS AND PERCENTAGES DIGESTED.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
SHEEP I.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Oat and vetch hay	1967.6	1818.0	149.6	210.5	610.2	927.6	69.7
Feces	851.7	791.7	60.0	69.2	323.4	378.7	20.4
Amount digested	1115.9	1026.3	89.6	141.3	286.8	548.9	49.3
Per cent digested	56.7	56.5	59.9	67.1	47.0	59.1	70.7
SHEEP II.							
Oat and vetch hay	1981.5	1830.9	150.6	211.5	615.8	933.7	69.9
Feces	784.5	721.7	62.8	62.1	309.0	332.9	17.7
Amount digested	1197.0	1109.2	87.8	149.4	306.8	600.8	52.2
Per cent digested	60.4	60.6	58.3	70.6	49.8	64.4	74.7
SHEEP III.							
Oat and vetch hay	2000.0	1848.2	151.8	212.8	623.2	942.0	70.2
Feces	734.7	676.6	58.1	62.4	264.4	333.0	16.8
Amount digested	1265.3	1171.6	93.7	150.4	358.8	609.0	53.4
Per cent digested	63.3	63.4	62.4	70.7	57.6	64.6	76.1
Average	60.1	60.2	60.2	69.5	51.5	62.7	73.8

FUEL VALUE FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Fuel value of urea.	Total available fuel value.	Per cent available fuel value.
FODDER: OAT AND VETCH HAY.						
Sheep I	8543	3927	4616	123	4493	52.6
Sheep II	8604	3649	4955	130	4825	56.1
Sheep III	8684	3358	5326	131	5195	59.8

DIGESTION EXPERIMENT 80—OAT AND PEA HAY.

RATIONS.

Fed Sheep I 500 grams per day.
Fed Sheep II 500 grams per day.
Fed Sheep III 500 grams per day.

WASTE LEFT BY EACH SHEEP FOR FIVE DAYS.

Sheep I.	Sheep II.	Sheep III.
26 grams.	50 grams.	75 grams.

COMPOSITION OF WASTE.

Water.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.
41.46	4.39	5.50	22.77	24.63	1.25

COMPOSITION OF FODDERS AND FECES.

	Laboratory number.	Dry matter.	WATER-FREE.						
			Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	Calories per gram.
FODDER.		%	%	%	%	%	%	%	
Oat and pea hay.	4222	74.93	92.09	7.91	13.76	33.38	41.99	2.96	4445
FECES.									
Sheep I........	4223	38.22	91.89	8.11	7.28	39.61	42.70	2.30	4575
Sheep II.........	4224	35.79	92.10	7.90	9.31	36.09	43.88	2.82	4592
Sheep III.........	4226	41.89	92.64	7.36	8.74	39.18	42.30	2.42	4650

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED IN FIVE DAYS AND PERCENTAGES DIGESTED.

	Dry substance.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
SHEEP I.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Oat and pea hay............	1856.4	1709.5	146.9	256.2	618.7	779.5	55.0
Feces..............	785.8	722.1	63.7	57.2	311.3	335.5	18.1
Amount digested.	1070.6	987.4	83.2	199.0	307.4	444.0	36.9
Per cent digested...........	57.6	57.8	56.6	77.7	49.7	57.0	67.1
SHEEP II.							
Oat and pea hay	1843.3	1697.3	145.9	255.0	613.6	774.0	54.8
Feces..........................	812.0	747.9	64.1	75.6	293.1	356.4	22.9
Amount digested.	1031.3	949.4	81.8	179.4	320.5	417.6	31.9
Per cent digested............	55.9	55.9	56.1	70.3	52.2	54.	58.2
SHEEP III.							
Oat and pea hay	1826.4	1681.7	144.7	253.4	607.0	766.9	54.4
Feces........................	694.1	643.0	51.1	60.7	271.9	293.6	16.8
Amount digested.	1132.3	1038.7	93.6	192.7	325.1	473.3	37.6
Per cent digested............	62.0	61.8	64.7	76.0	53.6	61.7	69.1
Average.	58.5	58.5	59.1	74.7	51.8	57.6	64.8

FUEL VALUE FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Fuel value of urea.	Total available fuel value.	Per cent available fuel value.
FODDER: OAT AND PEA HAY.						
Sheep I.	8252	3595	4657	173	4484	54.3
Sheep II	8194	3729	4465	156	4309	52.6
Sheep III..................	8118	3228	4890	168	4722	58.2

DIGESTION EXPERIMENT 81—HAY, MOSTLY TIMOTHY.

RATIONS.

Fed Sheep I 800 grams hay per day.
Fed Sheep II 800 grams hay per day.
Fed Sheep III 800 grams hay per day.

COMPOSITION OF FODDERS AND FECES.

	Laboratory number.	Dry matter.	Water-free.						
			Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.	Calories per gram.
Fodder.		%	%	%	%	%	%	%	
Hay	4240	87.00	93.89	6.11	7.12	32.43	51.62	2.72	4599
Feces.									
Sheep I	4241	....	89.39	10.61	7.93	30.86	47.99	2.61	4530
Sheep II	4242	....	91.00	9.00	6.65	32.68	49.19	2.48	4578
Sheep III.	4243	....	91.05	8.95	7.04	33.31	48.09	2.61	4603

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED IN FIVE DAYS AND PERCENTAGES DIGESTED.

	Dry matter.	Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.
SHEEP I.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Hay	3480.0	3267.4	212.6	247.8	1128.6	1796.4	94.6
Feces	1501.1	1341.8	159.3	119.0	463.2	720.4	39.2
Amount digested	1978.9	1925.6	53.3	128.8	665.4	1076.0	55.4
Per cent digested	56.8	58.9	25.1	52.0	59.0	59.9	58.6
SHEEP II.							
Hay	3480.0	3267.4	212.6	247.8	1128.6	1796.4	94.6
Feces	1723.6	1568.5	155.1	114.6	563.3	847.8	42.8
Amount digested	1756.4	1698.9	57.5	133.2	565.3	948.6	51.8
Per cent digested	50.5	52.0	27.0	53.7	50.1	52.8	54.8
SHEEP III.							
Hay	3480.0	3267.4	212.6	247.8	1128.6	1796.4	94.6
Feces	1634.3	1488.0	146.3	115.1	544.4	785.9	42.6
Amount digested	1845.7	1779.4	66.3	132.7	584.2	1010.5	52.0
Per cent digested	53.0	54.5	31.2	53.5	51.8	56.3	55.0
Average	53.4	55.1	27.8	53.1	53.6	56.3	56.1

FUEL VALUES FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Fuel value of urea.	Total available fuel value.	Per cent available fuel value.
FODDER: HAY.						
Sheep I	15973	6800	9173	112	9061	56.7
Sheep II	15973	7889	8084	116	7968	49.9
Sheep III	15973	7523	8450	115	8335	52.2

DIGESTION EXPERIMENT 82—OATS FED WITH HAY.

RATIONS.

Fed Sheep I 400 grams oats and 400 grams hay per day.
Fed Sheep II 400 grams oats and 400 grams hay per day.
Fed Sheep III 400 grams oats and 400 grams hay per day.

Sheep I left 177 grams waste for the five days.

COMPOSITION OF FODDERS AND FECES.

			WATER-FREE.						
	Station number.	Dry matter.	Organic matter.	Ash.	Protein.	Crude Fiber.	Nitrogen-free extract.	Fat.	Calories per gram.
FODDER.		%	%	%	%	%	%	%	
Hay..............	4235	87.00	93.89	6.11	7.12	32.43	51.62	2.72	4599
Oats	4234	86.84	96.93	3.63	13.10	11.87	65.71	5.69	4685
FECES.									
Sheep I........	4236	....	91.89	8.11	8.26	30.83	50.24	2.56	4681
Sheep II........	4237	....	92.07	7.93	7.91	31.85	50.07	2.24	4651
Sheep III........	4238	....	90.41	9.59	8.44	30.18	49.34	2.45	4588

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED IN FIVE DAYS AND PER CENT DIGESTED.

	Dry matter.	Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.
Sheep I.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Fed in hay	1582.3	1484.0	98.3	117.7	515.5	806.1	44.7
Fed in oats	1736.8	1673.8	63.0	227.5	206.2	1141.3	98.8
Total fed	3319.1	3157.8	161.3	345.2	721.7	1947.4	143.5
Total feces	1213.0	1114.6	98.4	100.2	374.0	609.4	31.0
Total digested	2106.1	2043.2	62.9	245.0	347.7	1338.0	112.5
Digested from hay	898.8	874.1	24.7	61.2	304.1	482.8	26.2
Digested from oats	1207.3	1169.1	38.2	183.8	43.6	855.2	86.3
Per cent digested from oats	69.5	69.8	60.6	80.8	21.1	74.9	87.3
Sheep II.							
Fed in hay	1740.0	1633.7	106.3	123.9	564.3	898.2	47.3
Fed in oats	1736.8	1673.8	63.0	227.5	206.2	1141.3	98.8
Total fed	3476.8	3307.5	169.3	351.4	770.5	2039.5	146.1
Total feces	1319.1	1214.5	104.6	104.3	420.1	660.5	29.6
Total digested	2157.7	2093.0	64.7	247.1	350.4	1379.0	116.5
Digested from hay	878.2	849.4	28.8	66.6	282.6	474.3	25.9
Digested from oats	1279.5	1243.6	35.9	180.5	67.8	904.7	90.6
Per cent digested from oats	73.6	74.3	57.0	79.3	32.9	79.3	91.7
Sheep III.							
Fed in hay	1740.0	1633.7	106.3	123.9	564.3	898.2	47.3
Fed in oats	1736.8	1673.8	63.0	227.5	206.2	1141.3	98.8
Total fed	3476.8	3307.5	169.3	351.4	770.5	2039.5	146.1
Total feces	1314.8	1188.7	126.1	111.0	396.8	648.7	32.2
Total digested	2162.0	2118.8	43.2	240.4	373.7	1390.8	113.9
Digested from hay	922.9	889.7	33.2	66.4	292.1	505.2	26.0
Digested from oats	1239.1	1229.1	10.0	174.0	81.6	885.6	87.9
Per cent digested from oats	71.3	73.4	15.9	76.5	39.5	77.6	89.0
Average	71.5	72.5	44.5	78.9	31.2	77.3	89.3

FUEL VALUES FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Fuel value of urea.	Total available fuel value.	Per cent available fuel value.
Fodder: Oats.						
Sheep I	8137	3179	4957	160	4797	60.0
Sheep II	8137	2190	5947	157	5790	71.2
Sheep III	8137	2270	4867	152	5715	70.2

DIGESTION EXPERIMENT 83—ROYAL OAT FEED.

RATIONS.

Fed Sheep I 400 grams Royal Oat Feed and 400 grams hay.
Fed Sheep II 400 grams Royal Oat Feed and 400 grams hay.
Fed Sheep III 400 grams Royal Oat Feed and 400 grams hay.

Left by Sheep I, 118 grams hay for five days.

COMPOSITION OF FODDERS AND FECES.

			WATER-FREE.						
	Station number.	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fut.	Calories per gram.
FODDER.		%	%	%	%	%	%	%	
Hay.............	4244	87.00	93.89	6.11	7.12	32.43	51.62	2.72	4599
Royal Oat Feed..	4245	89.63	93.61	6.39	7.46	24.98	57.73	3.44	4430
FECES.									
Sheep I........	4246	....	91.68	8.32	5.45	32.42	52.26	1.55	4478
Sheep II.........	4247	....	90.87	9.13	6.09	30.84	52.20	1.74	4472
Sheep III.........	4248	....	91.58	8.42	5.58	31.91	52.59	1.50	4480

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED IN FIVE DAYS AND PERCENTAGES DIGESTED.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
SHEEP I.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Fed in hay	1740	1633.7	106.3	123.9	564.3	898.2	47.3
Fed in "Royal Oat Feed"	1792.6	1678.1	114.5	133.7	447.8	1034.8	61.7
Total fed	3532.6	3311.8	220.8	257.6	1012.1	1933.0	109.0
Total feces	1789.1	1640.2	148.9	97.5	580.0	935.0	27.7
Total digested	1743.5	1671.6	71.9	160.1	432.1	998.0	81.3
Digested from hay	989.5	962.8	26.6	64.4	332.7	538.0	27.7
Digested from "Royal Oat Feed"	754.0	708.8	45.3	95.7	99.4	460.0	53.6
Per cent digested from "Royal Oat Feed"	42.1	42.2	39.6	71.6	20.0	48.9	86.8
SHEEP II.							
Fed in hay	1630.2	1529.8	100.4	118.0	528.0	838.0	45.8
Fed in "Royal Oat Feed"	1792.6	1678.1	114.5	133.7	447.8	1034.8	61.7
Total fed	3422.8	3207.9	214.9	251.7	975.8	1872.8	107.5
Total feces	1676.3	1523.3	153.0	102.1	517.0	875.0	29.2
Total digested	1746.5	1684.6	61.9	149.6	458.8	997.8	78.3
Digested from hay	822.7	795.5	27.1	63.4	264.5	442.5	25.1
Digested from "Royal Oat Feed"	923.8	889.1	34.8	86.2	194.3	555.3	53.2
Per cent digested from "Royal Oat Feed"	51.3	53.0	32.9	64.5	43.4	53.7	86.2
SHEEP III.							
Fed in hay	1696.3	1592.4	103.9	121.6	549.9	874.2	46.7
Fed in "Royal Oat Feed"	1792.6	1678.1	114.5	133.7	447.8	1034.8	61.7
Total fed	3488.9	3270.5	218.4	255.3	997.7	1909.0	108.4
Total feces	1710.8	1566.7	144.1	95.5	545.9	899.7	25.7
Total digested	1778.1	1703.8	74.3	159.8	451.6	1009.3	82.7
Digested from hay	906.8	877.5	28.9	64.6	294.7	492.2	26.2
Digested from "Royal Oat Feed"	871.3	826.3	45.4	95.2	156.9	517.1	56.5
Per cent digested from "Royal Oat Feed"	48.6	49.2	39.7	71.2	35.9	50.0	91.6
Average	47.3	48.1	37.4	69.1	33.1	50.9	88.2

FUEL VALUE FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Fuel value of urea.	Total available fuel value.	Per cent available fuel value.
ROYAL OAT FEED.						
Sheep I	7941	4612	3329	83	3246	40.9
Sheep II	7941	3651	4290	75	4215	53.1
Sheep III	7941	3902	4039	83	3956	49.8

DIGESTION EXPERIMENT 84—MIXED FEED.

RATIONS.

Fed Sheep I 400 grams mixed feed and 400 grams hay.
Fed Sheep II 400 grams mixed feed and 400 grams hay.
Fed Sheep III 400 grams mixed feed and 400 grams hay.

COMPOSITION OF FODDERS AND FECES.

			WATER-FREE.						
	Station number.	Dry matter.	Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.	Calories per gram.
FODDER.		%	%	%	%	%	%	%	
Hay	4251	87.00	93.89	6.11	7.12	32.43	51.62	2.72	4599
Mixed feed	4250	87.64	94.27	5.73	12.98	14.56	62.11	4.62	4513
FECES.									
Sheep I	4252	....	90.07	9.93	9.80	30.16	48.28	1.83	4459
Sheep II	4253	....	90.12	9.88	9.71	30.28	48.27	1.86	4429
Sheep III	4254	....	89.97	10.03	9.93	28.73	49.02	2.29	4449

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED IN FIVE DAYS AND PERCENTAGES DIGESTED.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
SHEEP I.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Fed in hay	1740	1633.7	106.3	123.9	564.3	898.2	47.3
Fed in mixed feed	1752.8	1652.4	100.4	227.5	255.2	1088.7	81.0
Total fed	3492.8	3286.1	206.7	351.4	819.5	1986.9	128.3
Total feces	1468.2	1322.4	145.8	143.9	442.6	708.9	26.9
Total digested	2024.6	1964.7	60.9	207.5	376.9	1278.0	101.4
Digested from hay	989.5	962.8	26.6	64.4	332.7	538.0	27.7
Digested from mixed feed	1035.1	1001.9	34.3	143.1	44.2	740.0	73.7
Per cent digested from mixed feed	59.1	60.6	34.2	62.9	17.3	68.0	91.0
SHEEP II.							
Fed in hay	1740	1633.7	106.3	123.9	564.3	898.2	47.3
Fed in mixed feed	1752.8	1652.4	100.4	227.5	255.2	1088.7	81.0
Total fed	3492.8	3286.1	206.7	351.4	819.5	1986.9	128.3
Total feces	1468.9	1323.8	145.1	142.6	444.8	709.1	27.3
Total amount digested	2023.9	1962.3	61.6	208.8	374.7	1277.8	101.0
Digested from hay	878.2	849.4	28.8	66.6	282.6	474.3	25.9
Digested from mixed feed	1145.7	1112.9	32.8	142.2	92.1	803.5	75.1
Per cent digested from mixed feed	65.4	67.4	32.7	62.5	36.1	73.8	92.7
SHEEP III.							
Fed in hay	1740	1633.7	106.3	123.9	564.3	898.2	47.3
Fed in mixed feed	1752.8	1652.4	100.4	227.5	255.2	1088.7	81.0
Total fed	3492.8	3286.1	206.7	351.4	819.5	1986.9	128.3
Total feces	1476.0	1330.2	145.8	143.3	446.9	712.5	27.5
Total digested	2016.8	1955.9	60.9	208.1	372.6	1274.4	100.8
Digested from hay	922.9	889.7	33.2	66.4	292.1	505.2	26.0
Digested from mixed feed	1093.9	1066.2	27.7	141.7	80.5	769.2	74.8
Per cent digested from mixed feed	62.4	64.5	27.6	62.3	31.5	70.7	92.4
Average	62.3	64.2	31.5	62.6	28.3	70.8	92.0

FUEL VALUE FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Fuel value of urea.	Total available fuel value.	Per cent available fuel value.
MIXED FEED.						
Sheep I	7909	2497	5412	125	5287	66.8
Sheep II	7909	1918	5991	124	5867	74.2
Sheep III	7909	2165	5753	123	5640	71.3

DIGESTION EXPERIMENT 85—CORN GERM.

RATIONS.

Fed Sheep I 300 grams corn germ, 400 grams hay per day.
Fed Sheep II 300 grams corn germ, 400 grams hay per day.
Fed Sheep III 300 grams corn germ, 400 grams hay per day.

COMPOSITION OF FODDERS AND FECES.

	Station number.	Dry matter.	WATER-FREE.						
			Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.	Calories per gram.
FODDER.		%	%	%	%	%	%	%	
Hay	4235	87.00	93.89	6.11	7.12	32.43	51.62	2.72	4599
Corn Germ	4227	90.42	96.05	3.95	25.37	23.72	35.68	11.28	5110
FECES.									
Sheep I	4255	....	90.06	9.94	12.57	30.70	44.59	2.20	4527
Sheep II	4256	....	91.05	8.95	12.66	30.34	45.64	2.41	4603
Sheep III	4257	....	89.65	10.31	14.53	29.30	43.55	2.31	4520

TOTAL NUTRIENTS IN FOOD EATEN AND FECES EXCRETED IN FIVE DAYS AND PERCENTAGES DIGESTED.

	Dry matter.	Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.
SHEEP I.	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Fed in hay	1740.0	1633.7	106.3	123.9	564.3	898.2	47.3
Fed in corn germ	1456.3	1398.8	57.5	369.2	345.4	519.7	164.4
Total fed	3196.3	3032.5	163.8	493.1	909.7	1417.9	211.7
Total feces	1135.2	1022.3	113.0	142.7	348.4	506.1	25.0
Total digested	2061.1	2010.2	50.8	350.4	561.3	911.8	186.7
Digested from hay	989.5	962.8	26.6	64.4	332.7	538.0	27.7
Digested from corn germ	1071.6	1047.4	24.2	286.0	228.6	373.8	159.0
Per cent digested from corn germ	73.6	74.9	42.1	77.5	66.2	71.9	96.7
SHEEP II.							
Fed in hay	1740.0	1633.7	106.3	123.9	564.3	898.2	47.3
Fed in corn germ	1456.3	1398.8	57.5	369.2	345.4	519.7	164.4
Total fed	3196.3	3032.5	163.8	493.1	909.7	1417.9	211.7
Total feces	1151.5	1048 4	103.1	145.8	349.4	525.6	27.8
Total digested	2044.8	1984.1	63.7	347.3	560.3	892.3	183.9
Digested from hay	989.5	962.8	26.6	64.4	332.7	538.0	27.7
Digested from corn germ	1055.3	1021.3	37.1	282.9	227.6	354.3	156.2
Per cent digested from corn germ	72.5	73.0	64.5	76.6	65.9	68.2	95.0
SHEEP III.							
Fed in hay	1740.0	1633.7	106.3	123.9	564.3	898.2	47.3
Fed in corn germ	1456.3	1398.8	57.5	369.2	345.4	519.7	164.4
Total fed	3196.3	3032.5	163.8	493.1	909.7	1417.9	211.7
Total feces	1116.2	1001.1	115.1	162.2	327.1	486.1	25.7
Total digested	2080 1	2031.4	48.7	330.9	582.6	931.8	186.0
Digested from hay	989.5	962.8	26.6	64.4	332.7	538.0	27.7
Digested from corn germ	1090.6	1068.6	22.1	266.5	249.9	393.8	158.3
Per cent digested from corn germ	74.9	76.4	38.4	72.2	72.4	75.8	96.4
Average	73.7	74.8	48.3	75.4	68.2	71.9	96.0

FUEL VALUE FOR FIVE DAYS.

	Fuel value of food.	Fuel value of feces.	Fuel value of food digested.	Fuel value of urea.	Total available fuel value.	Per cent available fuel value.
FODDER: CORN GERM.						
Sheep I	7442	1739	5703	249	5454	73.3
Sheep II	7442	1356	6086	246	5840	78.5
Sheep III	7442	1282	6159	232	5927	79.6

SUMMARY OF DIGESTION COEFFICIENTS OBTAINED IN THE EXPERIMENTS HERE REPORTED.

	Number of experiment.	Dry matter.	Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.
	%	%	%	%	%	%	%	%
Clover hay, cut in early bloom	70	57.6	59.0	44.6	65.9	51.8	62.9	27.9
Clover hay, cut in late bloom......	71	55.6	57.2	38.5	67.3	43.6	64.3	35.4
Clover silage made from clover cut in late bloom	72	52.3	53.3	44.0	39.7	55.2	55.8	54.1
Corn meal..........................	73	88.5	89.0	68 7	72.9	....	91.7	80.6
Hay, mostly timothy	74	57.6	57.9	53.5	65.2	48.0	63.0	44.6
Oats	75	69.2	71.3	.....	75.5	30.8	77.2	.....
Pea and oat hay......................	76	64.2	62.5	58.2	72.2	63.0	63.7	54.4
Oat and pea silage	77	65.5	66.6	52.4	74.6	61.3	67.0	75.0
Oat and vetch hay	78	55.4	56.2	44.3	65.3	49.0	59.0	62.8
Oat and vetch hay	79	60.1	60.2	60.2	69.5	51.5	62.7	73.8
Oat and pea hay....................	80	58.5	58.5	59.1	74.7	51.8	57.6	64.8
Hay, mostly timothy	81	53.4	55.1	27.8	53.1	53.6	56.3	56.1
Oats	82	71.5	72.5	44.5	78.9	31.2	77.3	89.3
Royal oat feed........................	83	47.3	48.1	37.4	69.1	33.1	50.9	88.2
Mixed feed	84	62.3	64.2	31.5	62.6	28.3	70.8	92.0
Corn germ	85	73.7	74.8	48.3	75.4	68.2	71.9	96.0

A COMPARISON OF DETERMINED AND CALCULATED HEATS OF COMBUSTION.

L. H. Merrill.

It has been frequently observed in this laboratory and elsewhere that the heats of combustion of vegetable foods as determined are higher than the results obtained by calculation when the usual factors are employed. This fact is illustrated by the wheat products in the following table in which it will be seen that the differences range from .026 to .430 calories, or from nearly one to ten percent of the determined value. The wheat products were chosen because they contain nutrients of precisely the same character and origin, but in varying proportions. The milling products are placed in the table below the wheats from which they were derived. The caluculated results are obtained by the use of Rubner's factors, viz.: for 1 gram protein, 5.5 calories: for fat, 9.3 calories; for carbohydrates, 4.1 calories.

HEATS OF COMBUSTION OF WHEATS AND THEIR MILLING PRODUCTS.
DETERMINED COMPARED WITH THE CALCULATED VALUES.

Laboratory number.	Material.	Heats of Cumbustion.			Crude fiber.
		Determined.	Calculated.	Difference.	
		Calories	Calories.	Calories.	%
6301	Wheat	3.918	3.849	.069	2.00
6302	Flour, first grade	3.839	3.813	.026	.23
6303	Flour, second grade	3.892	3.843	.049	.29
6304	Middlings	4.169	4.023	.146	4.80
6305	Bran	4.163	3.933	.430	7.32
....	Wheat	3.922	3.833	.089	2.54
6296	Flour, first grade	3.768	3.679	.089	.16
6297	Flour, second grade	3.780	3.701	.079	.27
6299	Middlings	4.115	4.005	.110	3.20
6298	Bran	4.142	3.946	.196	7.18
6270	Wheat	3.987	3.892	.095	1.96
6273	Flour, high grade	3.942	3.864	.078	.33
6279	Flour, low grade	4.365	4.218	.147	2.47
6280	Middlings	4.350	4.075	.275	9.62
6281	Bran	4.196	3.900	.296	10.07

A very brief inspection of the table will show that the differences noted stand in very intimate relation to the amount of crude fiber present, and leads to a suspicion that the fiber is the disturbing element. If this be true we should expect to find the greatest difference between the determined and caluculated heats of combustion in those materials which are especially rich in fiber, such as the coarse fodders and feces of herbivorous animals. The following results of feeding experiments with sheep serve to illustrate this.

Laboratory number.	Fodders and Feces.	Crude fiber.	HEATS OF CONBUSTION.		
			Determined.	Calculated.	Difference.
		%	Calories.	Calories.	Calories.
4130	Oat hay..	30.74	4.209	3.719	.490
4131	Sheep feces from oat hay....................	33.65	4.290	3.682	.608
4160	Clover silage	33.43	4.184	3.638	.546
4161	Sheep feces from clover silage......	32.16	4.379	3.805	.574
4202	Oat and pea silage	31.12	4.209	3.984	.225
4204	Sheep feces from oat and pea silage	32.88	4.163	3.669	.494

The results given in the last column are not, however, proportional to the amount of crude fiber present, but are much greater in the feces. This suggested a study of the fiber itself. A quantity was prepared from both fodders and feces and burned in the usual manner. The results, reduced to a water- and ash-free basis are given here.

HEATS OF CONBUSTION OF CRUDE FIBER FROM FODDERS AND THEIR FECES CORRESPONDING.

Lab. No.	Source of crude fiber.	Heats of conbustion.	Lab. No.	Source of crude fiber.	Heats of conbustion.
4130	Oat hay................	4.405	4131	Feces from oat hay ..	4.662
4160	Clover silage.........	4.610	4161	Feces from clover silage	5.215
4202	Oat and pea silage ...	4.667	4204	Feces from oat and pea silage...........	4.820
	Average...........	4.561		Average.	4.899

The crude fiber from the feces had, in these three cases, an average determined fuel value over 7 per cent higher than that of the fiber from the corresponding fodders. In other words, the digestible crude fiber had a lower fuel value than that remaining in the feces, and consequently, lower than that of the mixture of carbohydrates included in that term as found in the original fodders.